Methyl bromide alternatives

Vol. 3, No. 4 October 1997

USDA

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New Zealand's Approach to the Loss of Methyl Bromide

The proposed world-wide ban on methyl bromide has countries across the world searching for economical alternatives.

Of the 160 tons of methyl bromide used in New Zealand during 1996, 56 tons were used for quarantine and preshipment (QPS). Since 1991, New Zealand's methyl bromide use for non-QPS has dropped by 35 percent. Horticultural and agricultural products make up 70 percent of New Zealand's economy.

"New Zealand's horticultural exports are dominated by apples and kiwifruit, with the most important markets being Europe, Southeast Asia, and the United States," says Tom Batchelor. He is co-chair of the Perishables Subcommittee of the United Nations Environment Programme Methyl Bromide Technical Options Committee. This subcommittee deals mainly with quarantine issues.

Some countries, like Japan, require fumigation of fruit with methyl bromide prior to export to control pests, such as codling moth, that could be present.

"Our economy depends on the survival of our horticultural and agricultural markets, and to do that we need alternatives to methyl bromide. The Market Access Science Group at HortResearch in Auckland has been working since 1985 to find environmentally and economically sustainable treatments for controlling quarantine pests," says Batchelor.

The group's research focuses on investigating the effectiveness of treatments such as heat, cold, controlled atmospheres (CAs), generally-regarded-as-safe (GRAS) compounds, energy treatments, and various combinations of these treatments.

"CAs, like 1.2 percent oxygen and 1 percent carbon dioxide, have the potential to control lightbrown apple moth (*Epiphyas postvittana*) and wheat bug (*Nysius huttoni*) on Royal Gala and Granny Smith apples," says Batchelor. "Both are quarantine pests on apple exports to the United States. Royal Gala

This newsletter provides information on research for methyl bromide alternatives from USDA, universities, and industry.

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tolerates the 17- to 20-hour treatment required to control lightbrown apple moth and wheat bug, but Granny Smith does not. Trials are continuing with heat and cold treatments in an effort to select a commercial treatment that controls pests without fruit damage," adds Batchelor.

Registered fumigants/pesticides for soil use in New Zealand include chloropicrin, metam sodium, and dazomet. "Chloropicrin as a soil treatment may become more widely used once the successful results found in Australia are transferred to New Zealand conditions," says Batchelor.

Nonchemical treatments such as natural substrates like composted pine bark, artificial substrates, biological control, and steam treatments are under investigation. "Steam treatment has been adopted in mushroom houses that once relied on methyl bromide for disinfestation,"says Batchelor.

New Zealand is developing systems aimed at reducing quarantine pests through various control measures that originate in the orchard or fields and continue at various points in the production chain—from the orchard to the export market.

"New Zealand is gathering data to demonstrate minimal risks from quarantine pests in the packed carton and developing documentation and systems for critical control points that provide phytosanitary assurance to our overseas trading partners," says Batchelor. He adds, "Interestingly, the security achieved from the systems approach often exceeds that achievable from methyl bromide fumigation."

Irradiation—An Overview of a Safe Alternative to Fumigation

It passes through food in the form of radiant energy, without leaving any residue. Ionizing radiation—that which produces enough energy to kill bacteria and other pathogens in food—involves the use of gamma rays produced by cobalt or cesium, or x rays. The Food and Drug Administration (FDA) has declared that low-dose irradiation of food presents no health risk.

In the 1920s, a French scientist discovered that irradiation could preserve food. During World War II, the U.S. Army tested irradiation on fruits, vegetables, dairy products, and meat. Irradiated food has been routinely used for years by NASA.

Donald W. Thayer, a research chemist with USDA's Agricultural Research Service, and colleagues at ARS' Food Safety Research Unit of the Eastern Regional Research Center in Wyndmoor, Pennsylvania, have been testing irradiation on food for 16 years.

Not only does irradiation extend the shelf life of fruits and vegetables, but it also kills pests. And, unlike methyl bromide, irradiation does not adversely affect the environment. Thayer likens irradiation to pasteurization. "When used with the proper handling and processing techniques, irradiation greatly reduces the risk that contaminated meat, poultry, and other foods will reach consumers."

Methyl bromide, which will be banned on January 1, 2001, is the primary fumigant that now allows fruits, vegetables, and grain to be transported across state lines and exported to other countries. Irradiation can serve the purpose—safely, economically, and effectively—for many of these commodities.

"Irradiation reduces the chance of foodborne pathogens reaching the consumer," says Thayer. "Scientific studies conducted worldwide over the past 40 years have shown irradiation to be a wholesome process."

According to Thayer, during the irradiation process, food never comes in contact with any radioactive material. The gamma rays, x rays, or electrons used in the process do not make food radioactive. Irradiation, he says, is similar to exposure to sunlight or being x-rayed for medical reasons. Specific doses of radiation can kill rapidly growing cells, such as those of insects or spoilage, and pathogenic bacteria. But the process has little effect on the food itself because there is no cellular activity in the food. The changes that do occur are similar to the effects of canning, cooking, or freezing food.

One concern that has been raised with irradiation is that it may affect

the nutritional aspect of food. Thayer reports that irradiation can minimally affect some very sensitive vitamins like B_1 in pork.

"But it has been estimated that if all the pork in the United States were to be irradiated, Americans would lose only 2.3 percent of the vitamin B_1 in their diets," Thayer says. "Irradiation converts small amounts of vitamin C in fruit to another equally usable form, so nothing is lost. In fact, multigenerational studies of animals fed irradiated foods show that not only is it safe, but the nutritive value remains virtually unchanged."

Herbs, spices, and seasonings can introduce bacteria that may cause spoilage or foodborne disease in food which must be stored or transported before reaching consumers. Some commercial food processors treat spices with methyl bromide to kill insects or with ethylene oxide to control bacteria and mold. Both of these chemicals are extremely toxic.

But most spices, herbs, and dry vegetable seasonings in the United States are treated with ionizing radiation, which was sanctioned for this particular use by FDA in 1986.

In 1963, FDA authorized the first use of irradiation to treat food in the United States. Wheat and wheat flour were irradiated to rid them of insects. An electron beam—a result of collaborative research between ARS and the U.S. Army—is used to kill insects on about 400,000 tons of wheat a year at the port of Odessa, Ukraine. This irradiation treatment is not used in the United States because for the time being we have other fumigants and methods of getting pests out of grain.

It was 23 years later, in 1986, that irradiation was approved to control insects and inhibit growth and ripening in fruits, vegetables, and grain. Irradiation increases the shelf life of very perishable sweet onions to 3 months and not only extends the shelf life of tomatoes, but also allows them to be picked when fully ripe. Most flavorless tomatoes taste that way because they're picked green to ensure they get to market before they rot. Zapped by irradiation, mushrooms can last for 3 weeks without browning or cap separation and strawberries can stay in the refrigerator for 3 weeks without decay or shrinkage.

Even the dreaded *Cyclospora* parasite succumbs to irradiation. Thayer and colleagues have completed four studies of this pest, which has recently been found on raspberries and strawberries.

"We used a dose of irradiation that is recommended for fresh fruit on raspberries infected with *Cyclospora*. Not only did the irradiation inactivate the parasite, but it also doubled the raspberries' shelf life," Thayer reports. "More research is planned on irradiating *Cyclospora*, but it reacts in much the same way as *Toxoplasma gondii*, a species of organism that continues to sporulate after irradiation but does not multiply in its host."

Most of Thayer's irradiation work has been with meat to rid it of harmful microorganisms that cause foodborne illnesses. He was the first to discover that *E. coli* 0157:H7 could be controlled by radiation, and he and colleagues have successfully used irradiation against other foodborne pathogens including *Bacillus cereus, Clostridium botulinum, Listeria monocytogenes, Salmonella, Staphylococcus aureus,* and *Toxoplasma gondii* on meat and poultry. FDA's 1990 approval to use irradiation on poultry to eliminate harmful pathogens was, in part, a result of Thayer's research, as is the pending petition for approval to irradiate red meat.

In addition to USDA scientists and FDA, the list of endorsers of irradiation includes the U.S. Department of Health and Human Services, U.S. Public Health Service, U.S. Army, National Association of State Departments of Agriculture, American Medical Association, American Dietetic Association, American Meat Institute, Institute of Food Technologists, and National Food Processors Association. The World Health Organization and the Codex Alimentarius Commission sanction the use of irradiation, which is also being used in about 40 other countries.

"A safe, effective alternative to methyl bromide, irradiation has no harmful side effects," Thayer says.

New Regs Allow Movement of Hawaii Produce

Hawaii—blue skies, balmy breezes, beautiful flowers, and bountiful exotic fruit. Things that the mainland dreams of and wants. But one thing the mainland doesn't want is Hawaii's wide range of pests. Movement of exotic fruit from Hawaii is regulated to keep these pests—including the Mediterranean fruit fly, the melon fly, and the oriental fruit fly (a trio known as Trifly)—from the mainland. The litchi fruit moth and the mango weevil are among other pests found in Hawaii that are unwelcome on the mainland.

But amended regulations will allow some of Hawaii's tropical produce, with the help of irradiation, to move safely and more freely to the mainland.

"As early as 1956, Agricultural Research Service (ARS) scientists proposed irradiation as a quarantine treatment for Hawaii-grown fruits," reports John W. Armstrong. He is with the ARS Tropical Fruit, Vegetable, and Ornamental Crop Research Laboratory in Hawaii. "Nothing much came of the work for years because at the time we still had ethylene dibromide (EDB) and we also had methyl bromide. These chemicals were the first choice of export fruit industries because they were considered relatively safe, effective, and inexpensive."

But EDB was banned in 1984 and methyl bromide will be gone in 2001. The ARS research staff in Hawaii has been preparing for these possibilities for years. Armstrong and colleagues have been studying alternative measures to chemical fumigation since the 1970s. They've developed, tested, and successfully used vapor heat, forced hot air, hot-water immersion, and cold treatments. The nonhost status of crops was investigated to see if some fruits and vegetables could escape fumigation if no quarantine pests were found.

And they resurrected the idea of irradiation.

"The use of irradiation as a quarantine treatment against fruit flies was delayed by the lengthy process required to get approval from the Food and Drug Administration (FDA). FDA needed assurance that irradiation is a safe, effective treatment for fresh fruits," Armstrong says. "And, ARS showed the treatment was effective."

"Some fruits can't tolerate irradiation; it can alter the quality, depending on the dose. From a database that we had accumulated since 1956, we developed a generic dose of irradiation that would kill fruit flies without damaging the quality of the fruit," Armstrong says.

Based on this work, FDA approved irradiation as a quarantine treatment for fruit and vegetables in 1986, and in 1987, USDA's Animal and Plant Health Inspection Service (APHIS) issued regulations supporting irradiation treatment to disinfest papaya.

But even though approval has been granted, industry and the public are still cautious about accepting irradiation. Armstrong says that in the late 1980s, a combined federal and state program to construct an irradiation facility in Hawaii failed for lack of industry and public support and sufficient construction funds. This facility had been proposed primarily for the papaya industry to demonstrate the use of irradiation.

But in 1995, ARS joined forces with the Hawaii Department of Agriculture (HDOA), Hawaii export industries, and APHIS to revisit the issue of using irradiation as a quarantine treatment. The commercial feasibility of using irradiation needed to be proven.

"APHIS granted HDOA a special permit to ship untreated fruit from Hawaii to Chicago. There the fruit was irradiated and dispersed to grocery stores in a number of states," Armstrong reports.

Armstrong's lab sent infested fruits to Chicago along with those from HDOA to show that the recommended dose of irradiation provided quarantine security by killing pests in the fruit. Infested fruits, which were shipped only during the winter months and under secure conditions that prevented insects from escaping, were returned to the lab after irradiation.

"Our lab also tested the recommended irradiation treatment for Mediterranean fruit fly, melon fly, and oriental fruit fly against the Malaysian fruit fly, which became established in Hawaii in the early

1980s," Armstrong says. "Our tests showed that the recommended treatment was more than adequate to kill or prevent adult emergence of the Malaysian fruit fly."

Consumer acceptance of the irradiated fruit was excellent. A company specializing in irradiation facilities plans to build a quarantine treatment plant in Hawaii in the near future.

In July 1997, APHIS published amended regulations that now allow papayas, carambolas, and litchis from Hawaii to be irradiated either in Hawaii or in areas of the mainland United States where fruit flies can't survive winter conditions.

Under the new regulations, litchis must be inspected and declared free of the litchi fruit moth and other plant pests, then either irradiated or treated with hot water (a treatment also developed by Armstrong's lab) to kill potential fruit flies. So, while allowing Hawaii growers to move their produce, the new regulations also protect the U.S. mainland from unwanted pests.

"Irradiation is another tool we can use to disinfest fresh fruits before moving them through export market channels," Armstrong says. "But, we need to be aware that it is not a silver bullet, because some fruits can't tolerate irradiation."

California Monitors Methyl Bromide Applications for 6 Months

The California Environmental Protection Agency's Department of Pesticide Regulation (DPR) is well into its 6-month effort to monitor methyl bromide applications throughout the state. Scientists working on the project, which began in July 1997 and goes through February 1998, monitor about two fumigations each month. They set up buffer zones between fumigation sites and residential areas to measure levels of methyl bromide in the air 48 hours after application. Meteorological data are being collected to measure wind speed, wind direction, ambient temperature, and relative humidity.

This work is a result of action taken by DPR and California county agricultural commissioners in 1993 to ensure better protection for workers and others who may be exposed if methyl bromide escapes fumigation sites. A buffer zone is the area between the edge of a field treated with methyl bromide and nearby occupied buildings or land areas, like parks. The zone extends in all directions around the treated area. Buffer zones are set so that concentrations measured at this distance don't exceed an average of 210 parts per billion (ppb) over 24 hours—0.21 parts per million (ppm)—which builds in a 100-fold margin of safety for possible exposure. This level is 100 times lower than safe exposure levels established by toxicology tests.

California is the only state thus far to adopt these safety measures, which far exceed national standards. The safety measures are based on more than 1,000 field-measured air samples from 11 fumigations where the buffer zone provided at least a 100-fold safety margin. Although these tests were done in the summer, DPR did additional monitoring during the winter of 1997 to evaluate methyl bromide air concentrations in cold, stable air conditions.

"Because of cold air possibly draining down a slope and causing higher methyl bromide concentrations, we required a buffer zone of 200 feet for the side of the field that slopes toward residences," explains Paul H. Gosselin. "And, we established a 30-foot buffer on all other sides."

He is assistant director of DPR's Division of Enforcement, Environmental Monitoring, and Data Management.

In Monterey County, DPR monitored two separate applications to a 22-acre field where methyl bromide was injected 12 inches beneath the soil surface by shanks attached to a tractor. Growers had applied 300 pounds per acre of a mixture of 80 percent methyl bromide and 20 percent chloropicrin, then covered the treated area with a very high barrier tarpaulin.

Air samplers with activated charcoal tubes were placed around the treated area and wind speed and direction and relative humidity

were recorded every 5 minutes. Air samples were taken from 13 locations around the field in the first application and 17 in the second. A series of 5 samples was collected from each of the locations beginning with the start of fumigation during two 6-hour periods and three 12-hour periods for a total of 48 hours. Samples were analyzed by the California Department of Food and Agriculture's Center for Analytical Chemistry.

"During the first application, methyl bromide was not detected 200 feet from the edge of the field. Our sampling method can detect concentrations as low as 10 ppb," Gosselin reports. "During the second application, however, levels as high as 0.199 ppm were detected 200 feet from the edge of the field."

Although the methyl bromide detected didn't exceed the target level of 210 ppb at the buffer zone distances for either application, levels were higher than expected. Based on preliminary data, Gosselin thinks this could be attributed to weather factors. Wind speed during the night following the first application was less than 3 miles per hour for 3 of the 12 hours monitored. The night following the second application, wind speed was less than 3 mph for 5 of the 12 hours. Usually, the lower the wind speed, the higher the air concentration. Also, there was an overcast sky throughout the night of the first application, but clear skies during the night of the second application. Gosselin says that clear skies create more stable atmospheric conditions with less mixing of the air.

"All other factors being equal, a more stable atmosphere produces higher methyl bromide concentrations in the air," he says.

DPR has preliminary results from the first application at monitoring sites in Ventura County. In August, about nine acres were treated with 225 pounds per acre of an 80-20 mix of methyl bromide-chloropicrin. Weather data were again collected from a temporary weather station on site, and air samples were taken at 17 sites around the field. Eight samples were taken 30 feet from the field, 4 from 60 feet, 3 from 100 feet, and 2 from 200 feet.

"None of the samples showed levels of methyl bromide in excess of the 0.21 ppm target," Gosselin reports. As a result of the monitoring, DPR allowed the applications to this field to proceed but set a 100-foot buffer zone between it and an adjacent trailer park.

"DPR will change permit conditions for applying methyl bromide in the winter. At a minimum, we'll lengthen the buffer zones," Gosselin says.

Milling Industry Works To Reduce Reliance on Methyl Bromide

Remember watching Grandma steadily turn the crank on the flour sifter as she made the pumpkin pies for Thanksgiving? Ever think about why she was sifting the flour for the pie crust?

"She was making sure that only flour, and no insects, went into those pies," says Jim Bair, vice president of Millers' National Federation. "We in the milling industry are also concerned with quality. Our aim is to produce wholesome food products in a sanitary environment."

And with the help of methyl bromide, the milling industry has been doing that for years. Compared to other users in the agricultural sector, the milling industry is one of the smallest users of methyl bromide. But that use is a vital one, and in just a short time, methyl bromide will no longer be available.

"For years we've been trying to reduce our reliance on methyl bromide," Bair comments. "We use this chemical, which never touches our wheat or flour, to fumigate our milling structures with the idea that it's better to kill the pest before it reaches our products. And, we use only a fraction of what we're allowed to use. Although we've tried heat, CO_2, phosphine, and a combination of alternatives, we've found no single replacement that works as effectively as methyl bromide. This chemical allows the milling industry to comply with the Food and Drug Administration's (FDA) stringent regulations that mandate the sanitary conditions to ensure U.S. consumers wholesome, insect-free flour."

Insects can enter the mill in different ways, one of which is to come in with the grain.

But, Wendell Burkholder (ARS-Madison, Wisconsin) along with scientists from the University of Texas and Biotect, Inc., developed and patented a technique to detect insects in grain. This test can not only find live or dead insects, but can also detect insect fragments. The Millers' National Federation financed a grant to the University of Texas to support this effort. The test—which is close to commercialization—will, for the first time, allow millers to test grain before it reaches the mill. Millers now buy grain that gets dumped from railcars, hauled to grain elevators, and conveyed to the mill. If an insect is discovered at the mill, it would create difficulties. The new scientifically based ELISA (enzyme-linked immunosorbent assay) test allows millers to use a probe on the grain to check for insect infestation while it is still in the railcar. The test works on a variety of grain and milled grain products, including wheat, rice, barley, oats, and corn.

"If the miller finds insects at the railcar site, then the grain can be rejected," Bair says. "This puts the responsibility of keeping grain free of pests with the grain shipper and ultimately, the producer, who can do it more effectively and economically."

The milling industry, USDA, and universities recently completed a major study to compare this new test with current methods used by USDA inspectors (and sanctioned by FDA) in which the inspectors take a sample of grain, put it under a microscope, and count the number of insect fragments found in the sample.

How a Mill Is Fumigated

Methyl bromide is used to fumigate the physical structure of a mill and the equipment used in processing grain into flour. Fumigation is usually done twice a year, over a 3-day weekend to minimize downtime. Before the process begins, the flow of wheat from the storage facility to the mill is cut off. All grain residues are cleaned from milling equipment, which is left open for maximum exposure to methyl bromide. Since dust and grain particles affect the effectiveness of the treatment, the mill is thoroughly cleaned. Empty bins and bulk storages are also treated. At this point, no one is allowed in the building other than those applying the chemical. The building is then sealed to prevent escape of the methyl bromide.

"Only outside contractors or mill employees who are trained, certified, and licensed can apply the methyl bromide," Bair says. "Although EPA authorizes use up to 6.0 pounds per 1,000 cubic feet, we normally use only 1 to 1.5 pounds per 1,000 cubic feet, depending on the tightness and structural integrity of the building. An average flour mill contains between 1.5 million and 2 million cubic feet."

The methyl bromide gas is held in the mill for 24 hours, when certified personnel enter to begin the aeration process. Only after the air has been tested to ensure safety are workers allowed to enter the mill to remove the sealants and ready equipment and the mill for normal operation.

After startup, flour milled in the first 30 to 60 minutes is diverted into byproduct storage. This ensures that any residue which might linger in the equipment is not destined for human consumption.

Other Alternatives

High heat treatments have shown promise as an alternative to methyl bromide fumigation in certain facilities, Bair reports. But, some of the flour mills in the Untied States are more than 100 years old. Some of these mills are not structurally tight enough to effectively withstand raising and holding the temperature at high levels. Neither do they have the heating capacity to raise the temperature to levels that would kill insects.

"These old buildings have a lot of life left in them and it just isn't economically feasible to tear them down and build new structures that might tolerate high heat treatments or other potential alternatives," he says. "Also, it would cost a great deal to outfit one of these mills for heat treatments."

And although phosphine effectively treats stored grain, empty bulk storages, and grain and flour transport vehicles, there are technical problems with using it to fumigate mill structures. This is due, primarily, to the extensive electrical equipment necessarily

present in the mill. Phosphine is highly corrosive and could possibly damage this equipment.

Betsy Faga, president of the American Corn Millers Federation, agrees with Bair. "Our industries are similar. Corn dry milling is done in structures similar to flour mills. We, too, have tried heat, phosphine, and other combinations and have yet to find anything that works as well as methyl bromide without leaving any residue. And, we're also governed by phytosanitary standards set by the FDA."

"The milling industry believes that we must have an effective integrated pest management system to ensure that consumers get the safe, high-quality products they demand. But, with the final ban on methyl bromide only a short time away, there isn't much time to get that system in place," Bair says.

Heat Plus Powder Made From Algae Control Pests in Food Processing Plants

The largest amounts of methyl bromide used in Canada are primarily for fumigating mills and food processing plants. Therefore, it is not surprising that Canada has taken an active role in seeking methyl bromide alternatives. One possible option is the use of heat treatments.

Heat treatments to control stored-product insects is not a new practice for the Quaker Oats food processing plant in Peterborough, Ontario. A successful structural fumigation combining heat, phosphine, and CO_2 was conducted in 1996. Once again, the Quaker Oats facility donated its mill facility for a combined heat treatment field test. This time the combination used was heat and an enhanced diatomaceous earth (EDE) formulation, which is made from the fossilized skeletons of diatoms—single cell algae—and causes dehydration and damage to insect cuticles.

Processing facilities have been using heat combination treatments instead of, or in combination, with methyl bromide for more than 15 years. But many processors have concerns about the cost of heating equipment, the need for more frequent treatments, and the possible damage to buildings and equipment.

"USDA and Agriculture and Agri-Food Canada (AAFC) teamed up to find alternatives to methyl bromide. We began investigating ways to address some of the concerns about heat treatments," says Alan Dowdy a research entomologist with USDA's Agricultural Research Service, U.S. Grain Marketing Research Lab in Manhattan, Kansas.

"The Quaker Oats facility was an ideal place to test this trial, because it is typical of many other milling and cereal-processing facilities. It has a low relative humidity, like many food processing facilities. Some sections are more than 75 years old. Its structure consists of old, timber beams and floors, stone walls, and cement-on-soil surfaces—which make heat treatments difficult. These conditions help increase the efficacy of our tests," says Paul Fields, a research scientist with AAFC.

Four different treatments using heat alone, EDE alone, heat and EDE, and no heat or EDE were examined. Three different buildings and areas were used for the tests: (1) the oat mill—located in the basement of one building, (2) the hallway of another building, and (3) the equipment storage and cardboard compacting area—located in the basement of another building. The entire facility was cleaned the evening before the heat treatment.

In preparation for the heat treatment, different areas of the mill were treated with EDE as a powder using a power sprayer, a dry powder using a hand duster, a 20-percent liquid solution using a hand sprayer, or distributed in measured amounts of 1, 3, and 7 g/m^2 in plastic rings (15 cm diameter, 2 cm high, 0.018 m^2 area) placed on the floor. EDE, one of the main grain protectants, is a type of insecticide that works by sticking to and absorbing the waxy coatings on insects, causing their death by dehydration, says Dowdy.

The plastic rings allow the insects to be exposed to the heat treatment with space to move but prevents their escape into the food processing facility. The rings are sealed along the outside with plasticine to prevent bugs from escaping through cracks between the rings and the floor. Three rings, placed about 5 cm apart, are used for each treatment.

"We used adult confused flour beetles (*Tribolium confusum*) in our commercial test, because they are the main insect pest of food processing facilities. We placed them in vials with 10 grams of flour 2 days prior to the test, which was conducted March 14-16, 1997. Fifty beetles were placed in each ring between 3:00 and 5:00 p.m., on March 14. We checked mortality every 60 minutes and removed any dead insects," says Fields.

"In the heated areas, we found that the dry application of EDE gave a 100-percent death rate of the adult beetles after 13 to 22 hours and 106 °F compared to untreated insects, which required 32 to 38 hours and 115 °F to 117 °F," says Dowdy.

Relative humidity started at 19 percent and declined to 5 percent during the entire test. Peak temperatures were at or above 122 °F during the treatment.

This project demonstrates the effective combination of heat plus diatomaceous earth and the potential to reduce the temperature or time requirements necessary for effective insect control. (For a complete report on this project, contact Alan Dowdy, phone 913-776-2719; fax 913-537- 5584.)

Minor Use—What It Means

Although the term "minor use" doesn't sound significant, in reality it is—very much so. Minor use pesticides are applied to "minor use" crops. And minor use crops include many of our fruits, vegetables, nuts, ornamentals, and nursery products.

Although grown on only 8 million acres in the United States, minor crops are valued at around $24 billion annually, about 40 percent of all agricultural crop sales.

Because there are several hundred minor use crops, the easiest way to distinguish between them and major crops is to list the major crops. Major crops include almonds, apples, barley, beans (dry and snap), canola, corn (sweet and field), cotton, grapes, hay (alfalfa and other), oats, oranges, peanuts, pecans, popcorn, potatoes, rice, rye, sorghum, soybeans, sugar beets, sugarcane, sunflowers, tobacco, tomatoes, turf, and wheat.

In general, minor use of a pesticide in the United States means it is applied on a commercial agricultural crop or site to protect public health when the crop is grown on less than a total of 300,000 acres. The term also applies when the use on a major crop does not provide an economically viable return sufficient to merit pesticide registration with the Environmental Protection Agency (EPA), which can be an expensive process. There usually isn't sufficient economic incentive for registrants to provide data to support initial or continuing registration of the pesticides. About 70 percent of registration and reregistration actions by EPA's Office of Pesticide Programs involve minor use pesticides.

Methyl bromide is the primary fumigant used to protect minor crops from soil pathogens and to meet export-import phytosanitary requirements. And since there are only three crop seasons remaining before this fumigant is banned, concern is growing throughout the agricultural community. How will growers of minor crops survive this loss?

Minor crops are so important that Congress requires the EPA to consult growers on minor use issues, registrations, and amendments. The vehicle that carries specific congressional language to this effect is the new Food Quality Protection Act (FQPA).

The new FQPA, which became effective on August 3, 1996, mandated the establishment of minor-use programs in the USDA and in EPA. Often, potential registrants of alternative pesticides for minor crops have opted not to remain in the marketplace because of the cost of producing data required to register minor-use pesticides.

Because the new FQPA sets a higher standard for conventional pesticides, it encourages development of reduced-risk pesticides. As part of implementing the new act, USDA, EPA, and the Minor Crop Farmer Alliance held a news conference on September 8 to announce new plans.

"USDA has a new approach to the minor use pesticide issues," says Edward Knipling, acting adminis-

trator of the Agricultural Research Service (ARS). "Deputy Secretary Richard Rominger has established the Office of Pest Management to integrate and coordinate pesticide issues within USDA, while working with EPA, grower organizations, and crop specialists at land grant institutions. The expected results are accurate, high-quality data on pesticide use practices for regulatory decision making."

At the same time, EPA created a Minor Use Program Team charged to work closely with USDA, grower organizations, registrants, and other stakeholders to get the best data available.

Both new groups will work hard to develop an open dialogue with the minor use community and to promote development of safer pesticides for minor uses.

"USDA and EPA have been working to get funds to collect additional data on children's food consumption patterns and to collect pesticide residue information. These efforts are mandated by the Food Quality Protection Act, which requires that minor use issues be handled in a more efficient, coordinated, cross-agency way," Knipling reports.

The new group at USDA will coordinate issues such as pesticide use surveys, minor use registration data development, pesticide residue data, food consumption surveys, the pest management activities program, and integrated pest management.

"We recognize that maintaining a close, cooperative relationship with EPA is vital to ensure that the best possible data are given those at EPA who will make regulatory decisions on these issues," Knipling explains. "And because most of the pertinent information must come from growers and crop specialists at land grant institutions, our new Office of Pest Management will strengthen our cooperation and communication with them."

"In addition to initiating a minor use program in EPA, we're also offering incentives to manufacturers of minor use pesticides," reports Stephen Johnson, deputy director of EPA's Office of Pesticides Program. On a case-by-case basis, the new act allows EPA to

- extend time for exclusive use and submission of residue data,
- be flexible on data requirements,
- expedite registration,
- allow adequate time for submitting minor use data,
- extend, temporarily, continued use of unsupported uses,
- extend the comment period for voluntary cancellation to 180 days.

In ARS, Knipling says that Interregional Project No. 4 (IR-4) will continue to be a major part of USDA's minor use program.

"For years we've carried out major work on the minor use program through IR-4 research, which is partially funded from ARS congressional appropriations," he says. "The priorities have been on registering and reregistering pesticides for food crops, registering pesticides for ornamental crops, and registering biological pest control products for minor crops."

USDA's Cooperative State Research, Education, and Extension Service supports IR-4 through its Special Research Grant Program and from regional research funds earmarked by state experiment stations.

Established at the request of the state agricultural experiment stations in 1963, IR-4, with an annual budget of more than $8 million, is headed by Richard T. Guest, New Jersey Agricultural Experiment Station/Cook College/ Rutgers University, New Brunswick, New Jersey. Its purpose: collect data to support minor use registrations.

"The minor use issue could mean major problems if we don't find alternatives for growers when methyl bromide is banned in 2001," says Kenneth W. Vick, USDA methyl bromide coordinator. "If pest-induced losses increase, not only would growers be affected, but consumers would feel the pinch as well. Crop losses mean fewer products on the market and increased prices for what is available."

Dan Botts, chairman of the Minor Crop Farmer Alliance's Technical Committee, is encouraged by the recent joint action by USDA and EPA. He thinks there is hope for growers of minor crops.

"We've worked closely with USDA and EPA over the past year to establish these new offices that will address the concerns over minor crops. And we feel confident that producers' needs and interests will be more efficiently addressed under the current cooperative spirit between these two agencies," Botts says.

Technical Reports

Methyl Iodide as a Quarantine Treatment for Caribbean Fruit Fly

Principal Investigators: Jennifer L. Sharp, research entomologist, and Jimmie King, support chemist, Subtropical Horticulture Research Station, USDA-ARS, Miami, FL 33158.

Methyl bromide will be banned for use in Canada and the United States in 2001 because the chemical has been reported to destroy the ozone layer of the stratosphere. Methyl bromide is a broad spectrum fumigant used to control a multitude of pests, including nematodes, snails and slugs, mites, insects, and microorganisms. The loss of methyl bromide will cost consumers and producers billions of dollars unless a successful replacement can be found.

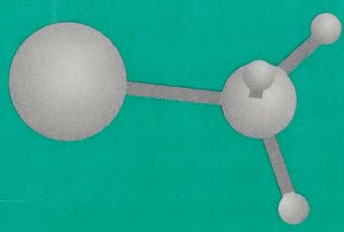
Unlike methyl bromide, methyl iodide is not considered a threat to the ozone layer because it is rapidly destroyed by ultraviolet light. Methyl iodide, however, acts as a biocide similar to methyl bromide. Methyl iodide has been tested successfully and shown to control soil and weed pests. Tests were initiated at the Subtropical Horticulture Research Station in July 1997 to investigate methyl iodide as a toxic fumigant to control Caribbean fruit fly eggs and larvae and to evaluate its effect on the market quality of treated fruits and one vegetable.

Fumigation chambers used in the experiments were 1-cubic-foot vacuum chambers modified by the addition of a circulation fan and sampling ports. The chambers were mounted in a fume hood so that the toxic vapors of methyl iodide could be vented easily. Test materials were placed in the chamber and then methyl iodide was measured and dispensed into petri dishes by using a microliter syringe. Metal "c" clamps pressed the vacuum doors firmly against the seals. Only 190 microliters of liquid methyl iodide (2.28 grams per milliliter) were needed for a dose of 16 grams per cubic meter. Methyl iodide boils at 108.5 °F and rapidly vaporized inside the chambers.

Grapefruit, guava, papaya, and chayote were fumigated for 1, 2, and 3 hours at a dose of 16 grams per cubic meter and then stored at 55.4 °F for a week to determine if the treatment damaged the market quality of the produce. Only the fumigated chayote showed injury, which was stem-end rot and brown areas caused by prior rough handling and exacerbated by the treatment.

Guavas infested with Caribbean fruit fly eggs and larvae in the field initially were fumigated for 2 hours with doses of 16, 32, and 48 grams per cubic meter. Treated eggs and larvae did not survive the treatments. Next, similarly infested guavas exposed to 16 grams per cubic meter of methyl iodide for 20, 30, and 40 minutes resulted in 54, 62, and 64 percent control, respectively, of the natural infestation of eggs and larvae. Caribbean fruit fly eggs 24 hours old obtained from a laboratory colony exposed to 2, 4, and 8 grams per cubic meter for 30 minutes resulted in 24, 49, and 90 percent control, respectively. Exposure of laboratory-reared mature larvae 7 days old to concentrations of 2, 4, and 8 grams per cubic meter for 30 minutes resulted in 96, 96, and 99 percent control, respectively.

If registered, methyl iodide would appear to be an effective methyl bromide alternative to control eggs and larvae of Caribbean fruit fly. Additional tests are being conducted to establish minimum doses required to meet quarantine rules and regulations.



Upcoming Meetings

San Diego, California—November 3-5, 1997

The fourth Annual International Research Conference on Methyl Bromide Alternatives and Emissions reduction will be held November 3-5 at the Double Tree San Diego Mission Valley Hotel in San Diego, CA (phone 619-297-5466 or 800-222-8733). Again sponsored by the U.S. Department of Agriculture, the Crop Protection Coalition, and the U.S. Environmental Protection Agency, the conference is being held to:

- Enhance scientific information and data exchange on methyl bromide alternatives research
- Provide a forum for exchange of interdisciplinary scientific and agricultural information
- Develop and distribute conference proceedings as a state-of-the-art methyl bromide alternatives source for researchers, users of methyl bromide, legislators, government policy officials, and the general public
- Support data gathering on potential alternatives to methyl bromide for future evaluation and prioritization
- Monitor development of viable alternatives to methyl bromide
- Evaluate technology transfer processes and incentive programs needed to implement alternatives.

For more details, contact Anna Williams, Methyl Bromide Alternatives Outreach, phone (209) 447-2127, fax (209) 436-0692.